PCT/AU99/01071

09/857104

PRIORITY DOCUMENT

SUBMITTED OR TRANSMITTED IN COMPLIANCE WITH RULE 17.1(a) OR (b)

Patent Office
Canberra

E.U.

I, KIM MARSHALL, MANAGER PATENT OPERATIONS hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. PP 7470 for a patent by ALCATEL filed on 04 December 1998.

WITNESS my hand this
Tenth day of January 2000

KIM MARSHALL
MANAGER PATENT OPERATIONS

P/00/009 28/5/91
Regulation 3.2

AUSTRALIA

Patents Act 1990

PROVISIONAL SPECIFICATION

Invention Title:

"A WAVEGUIDE DIRECTIONAL FILTER ARRANGEMENT"

This invention is described in the following statement:

This invention relates to the technology of combining multiple UHF TV broadcasting transmitters on to a common antenna.

In this technology it is known to provide a UHF filter/combiner system comprising an assembly of dual bandpass filters whose inputs and outputs are coupled by waveguide hybrid couplers. A disadvantage of this known system is its relatively large size. Another disadvantage of this system is that the dual bandpass filters must be electrically identical, which is difficult to accomplish due to their complexity.

It is also known to provide a UHF filter/combiner that comprises a cascade of dual mode resonant cavities with input and output coaxial coupling elements, such as the "ROTAMODE" device. However, a disadvantage of this form of construction is that the power handling capability of the coaxial input and output elements is limited.

It is also known to use a waveguide directional filter technique at microwave multi-point distribution system(MMDS) frequencies above 2GHz. Each TV channel at MMDS frequencies occupies a fractional bandwidth of much less than 1%. However, at UHF broadcasting frequencies in the range 470-860 MHZ, the fractional bandwidth of a TV channel is of the order of 1% or more, and a conventional waveguide directional filter does not provide a satisfactory electrical performance.

It is an object of the present invention to provide a waveguide directional filter arrangement which can be used at UHF broadcasting frequencies, and avoids the disadvantages of the aforementioned prior art.

According to a first aspect of the invention there is provided a waveguide directional filter arrangement comprising an input waveguide means and an output waveguide means connected by cavity resonator means, wherein said input waveguide means and said output waveguide means each include broad wall sections joined by narrow wall sections whose aspect ratio is greater than 2:1.

According to a second aspect of the invention there is provided a waveguide directional filter arrangement comprising an input waveguide means and an output waveguide means, wherein each said waveguide means includes an aperture means arranged to couple its associated waveguide means to a common resonator means, and wherein edges of each aperture means include inwardly extending sections.

According to a third aspect of the invention there is provided a waveguide

directional filter arrangement comprising an input waveguide means and an output waveguide means connected by cavity resonator means comprising at least three stacked resonator elements, wherein at least one pair of non-adjacent resonator elements include additional covering means to couple the non-adjacent resonator elements.

According to a fourth aspect of the invention there is provided a waveguide directional filter arrangement comprising an input waveguide means and an output waveguide means connected by a cavity resonator means comprising at least one resonator element, said input waveguide means and said output waveguide means each include broad wall sections joined by narrow wall sections whose aspect ratio is greater than 2:1, each said waveguide means includes an aperture means arranged to couple its associated waveguide means to said cavity resonator means, wherein edges of each aperture means include inwardly extending sections.

In order that the invention may be readily carried into effect, embodiments thereof will now be described in relation to the accompanying drawings, in which:

Figure 1 shows a waveguide directional filter assembly of the present invention.

Figure 2 shows a more detailed view of the aperture arrangement of the assembly shown in Figure 1.

Figure 3 shows an alternative aperture arrangement.

Figure 4 shows a waveguide direction filter assembly with additional coupling between non-adjacent resonators.

Referring to Figure 1, the assembly comprises an input waveguide 1 having a narrow band input port and an absorbing termination port; and an output waveguide 2 having a wideband input port and an output port. The waveguides are rectangular having broad walls 3 joined to narrow walls 4 whose aspect ratio is approximately 4:1.

Waveguides 1 and 2 are connected by six circularly cylindrical aperture coupled cavities 5. Coupling between adjacent cavities is provided by circular apertures 6.

Each end cavity is operatively coupled to its associated rectangular waveguide through a characteristically shaped aperture 7, 7a. Referring to Figure 2, aperture 7a, which is similar to aperture 7 in input waveguide 1, is in the form of a rectangle whose four sides have integral inwardly extending hemicycle sectors 8, 9, 10 and 11. These hemicycle sections provide increased coupling into the desired resonator mode.

It will be understood that the inwardly extending hemicycle sections can be in the form of discrete elements, such as for example discs, that can be attached around the edges of a basic rectangular aperture. The position of such discrete elements can be made adjustable to vary the coupling through the aperture.

Alternatively, the inwardly extending hemicycle sections can be in the form of cylinders 12, 13, 14 and 15 as shown in Figure 3. As with the above mentioned discs, the position of the cylinders can be adjustable to vary the coupling through the aperture. Moreover, the cylindrical form causes a greater reduction of coupling into undesirable modes.

Referring to Figure 4, non-adjacent resonator elements 16 and 17 of the waveguide directional filter assembly are provided with two additional coupling elements 19 and 20. Each coupling element comprises two probes 21 and 22 connected by a transmission line 23. The probes extend into the resonators and are disposed at 90^0 to one another.

The power handling capability of the waveguide directional filter arrangement described above can be enhanced by the addition of cooling fins (not shown) on one or more of the cavity resonators.

Also, tuning elements (not shown) can be added to the cavity resonators.

In operation, a narrow band signal is injected into the input port of input waveguide 1. This signal is coupled through aperture 7 into the first cavity resonator and launches a circularly polarised wave therein which is coupled through successive circularly cylindrical resonators 5 by means of circular apertures 6 to the output waveguide 2 via aperture 7a, where it produces a directional wave. This signal is added to any existing signals travelling through the same waveguide at other frequencies.

An absorbing termination coupled to waveguide 1 absorbs any power not coupled into the first resonator.

The reduced height of the waveguides improves the circularity of the circularly polarised wave in the resonators, which provides improved directional characteristics in the output waveguide across the operational band.

An advantage of the waveguide directional filter assembly of the present invention vis-a-vis the prior art assembly using separate hybrids and filters is that the assembly of

the present invention is relatively unaffected by temperature differentials which can occur between separate filters in a hybrid coupled configuration. Such temperature differentials lead to a degradation of performance.

The claims defining the invention are as follows:

1. A waveguide directional filter arrangement comprising input waveguide means and an output waveguide means connected by cavity resonator means, wherein said input waveguide means and said output waveguide means each include broad wall sections joined by narrow wall sections whose aspect ratio is greater than 2:1.

2. A waveguide directional filter arrangement comprising an input waveguide means and an output waveguide means, wherein each said waveguide means includes an aperture means arranged to couple its associated waveguide means to a common resonator means, and wherein edges of each aperture means include inwardly extending sections.

3. A waveguide directional filter arrangement comprising an input waveguide means and an output waveguide means connected by cavity resonator means comprising at least three stacked resonator elements, wherein at least one pair of non-adjacent resonator elements include additional coupling means to couple the non-adjacent resonator elements.

4. A waveguide directional filter arrangement comprising input waveguide means and output waveguide means connected by cavity resonator means comprising at least one resonator element, said input waveguide means and said output waveguide means each include broad wall sections joined by narrow wall sections whose aspect ratio is greater than 2:1, each said waveguide means includes an aperture means arranged to couple its associated waveguide means to said cavity resonator means, wherein edges of each aperture means include inwardly extending sections.

5. A waveguide directional filter arrangement as claimed in claim 4, comprising at least 3 stacked resonator elements, at least one pair of non-adjacent resonator elements including additional coupling means to couple the non-adjacent resonator elements.

6. A waveguide directional filter arrangement as claimed in claim 5, wherein the additional coupling means comprises a first pair of coupling elements each of which extend into a respective non-adjacent resonator element, said coupling elements being connected together by a first external transmission line means.

7. A waveguide directional filter arrangement as claimed in claim 6, including a second pair of coupling elements each of which extend into a respective non-adjecent

resonator element, said coupling elements of said second pair of coupling elements being connected together by a second external transmission line means, said first pair of coupling elements and said second pair of coupling elements being disposed in a pre-determined spaced relationship.

8. A waveguide directional filter arrangement as claimed in claim 7, wherein said first pair of coupling elements and said second pair of coupling elements are disposed at approximately 90^0 to each other.

9. A waveguide directional filter arrangement as claimed in any one of claims 2, 4 to 8, wherein said inwardly extending sections are approximately hemicycle-shaped planar sections.

10. A waveguide directional filter arrangement as claimed in claim 9, wherein said hemicycle-shaped planar sections are integral with said aperture means.

11. A waveguide directional filter arrangement as claimed in claim 9, wherein said hemicycle-shaped planar sections are in the form of discrete members attached proximate said edges of said aperture means.

12. A waveguide directional filter arrangement as claimed in claims 2, 4 to 8, wherein said inwardly extending sections are hemicycle-shaped portions of cylinders, whose axes are normal to said aperture's major plane.

13. A waveguide directional filter arrangement as claimed in claim 12, wherein said cylinders are integral with said aperture means.

14. A waveguide directional filter arrangement as claimed in claim 12, wherein said cylinders are in the form of discrete members attached proximate said edges of said aperture means.

15. A waveguide directional filter arrangement as claimed in claim11, wherein said discrete members include adjustment means for positional adjustment thereof.

16. A waveguide directional filter arrangement as claimed in claim 14, wherein said discrete cylinders include adjustment means for positional adjustment thereof.

17. A waveguide directional filter arrangement as claimed in any one of claims 4-16, wherein the aspect ratio of said wall sections is approximately 4:1.

18. A waveguide directional filter arrangement as claimed in any one of claims 3 to 17, wherein at least one said resonator element includes a plurality of cooling fins

operatively attached thereto.

19. A waveguide directional filter arrangement as claimed in any one of claims 3 to 18, wherein at least one said resonator element includes at least one tuning element means.

20. A waveguide directional filter arrangement as claimed in any one of the preceding claims, wherein said resonator element is symmetric.

21. A waveguide directional filter arrangement, substantially as herein described with reference to Figures 1-4 of the accompanying drawings.

DATED THIS TWENTY SEVENTH DAY OF NOVEMBER 1998

ALCATEL

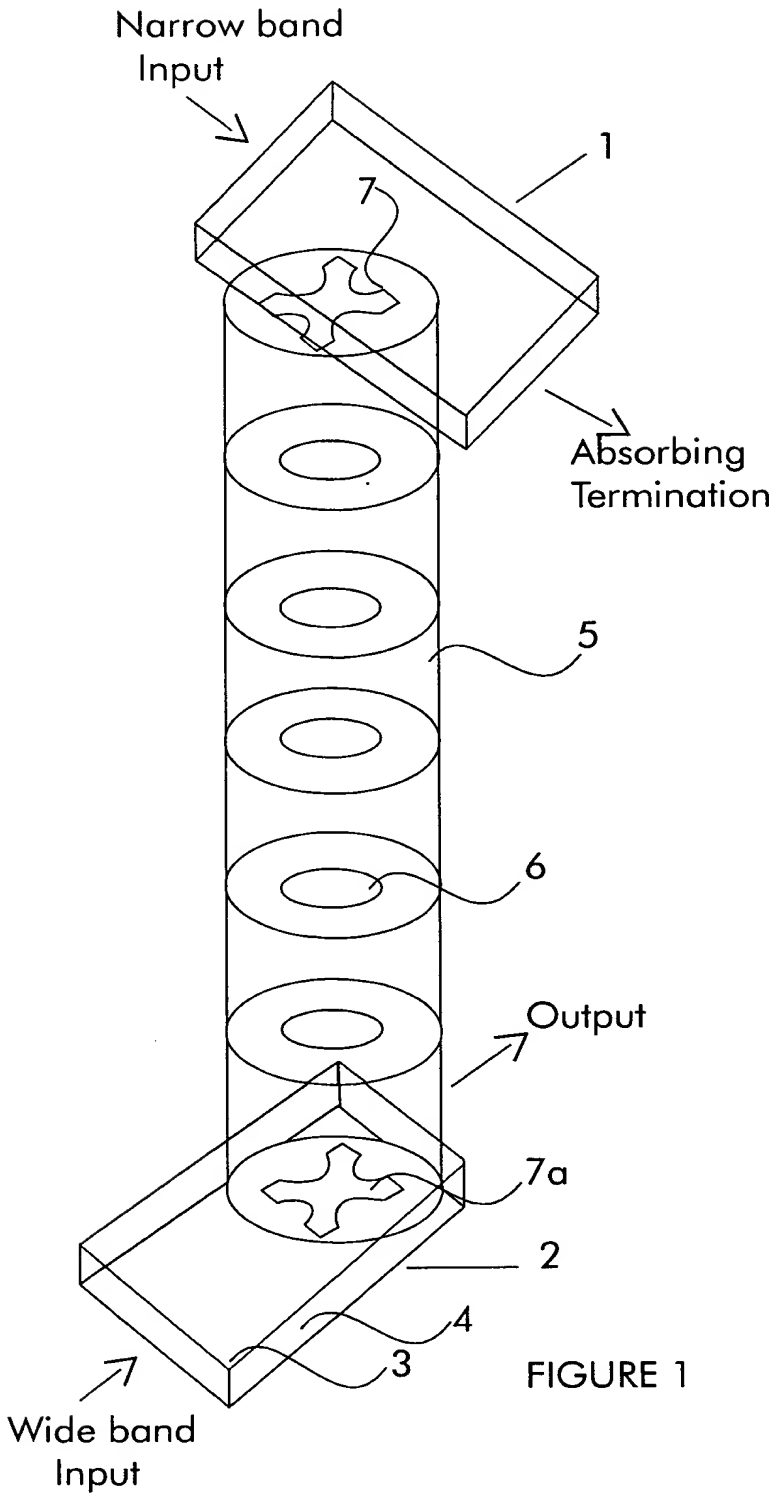
Narrow band
Input
1
7
Absorbing
Termination
5
6
Output
7a
2
4
3
Wide band
Input

FIGURE 1

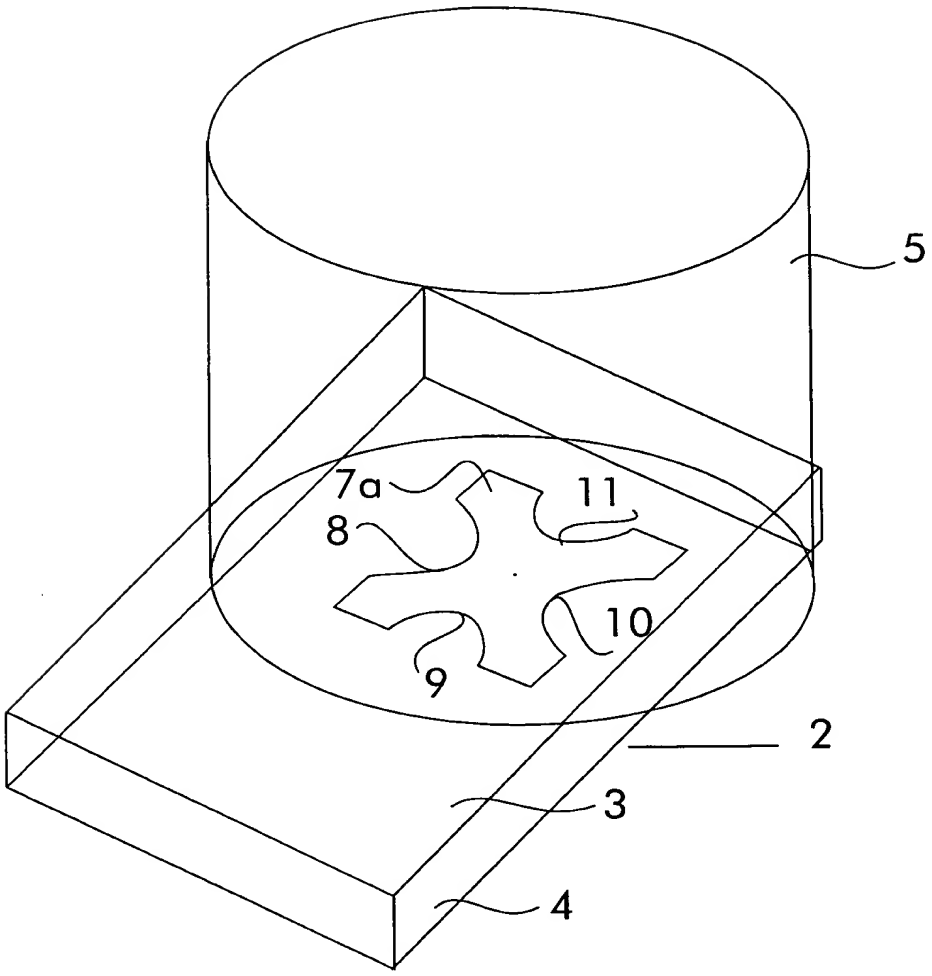

FIGURE 2

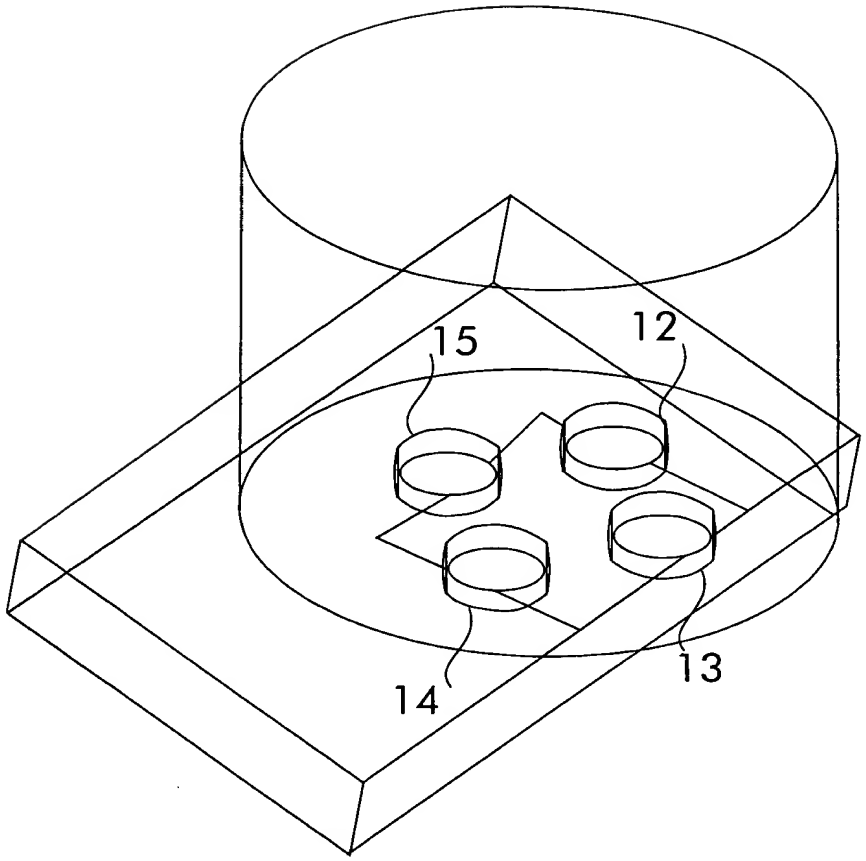

FIGURE 3

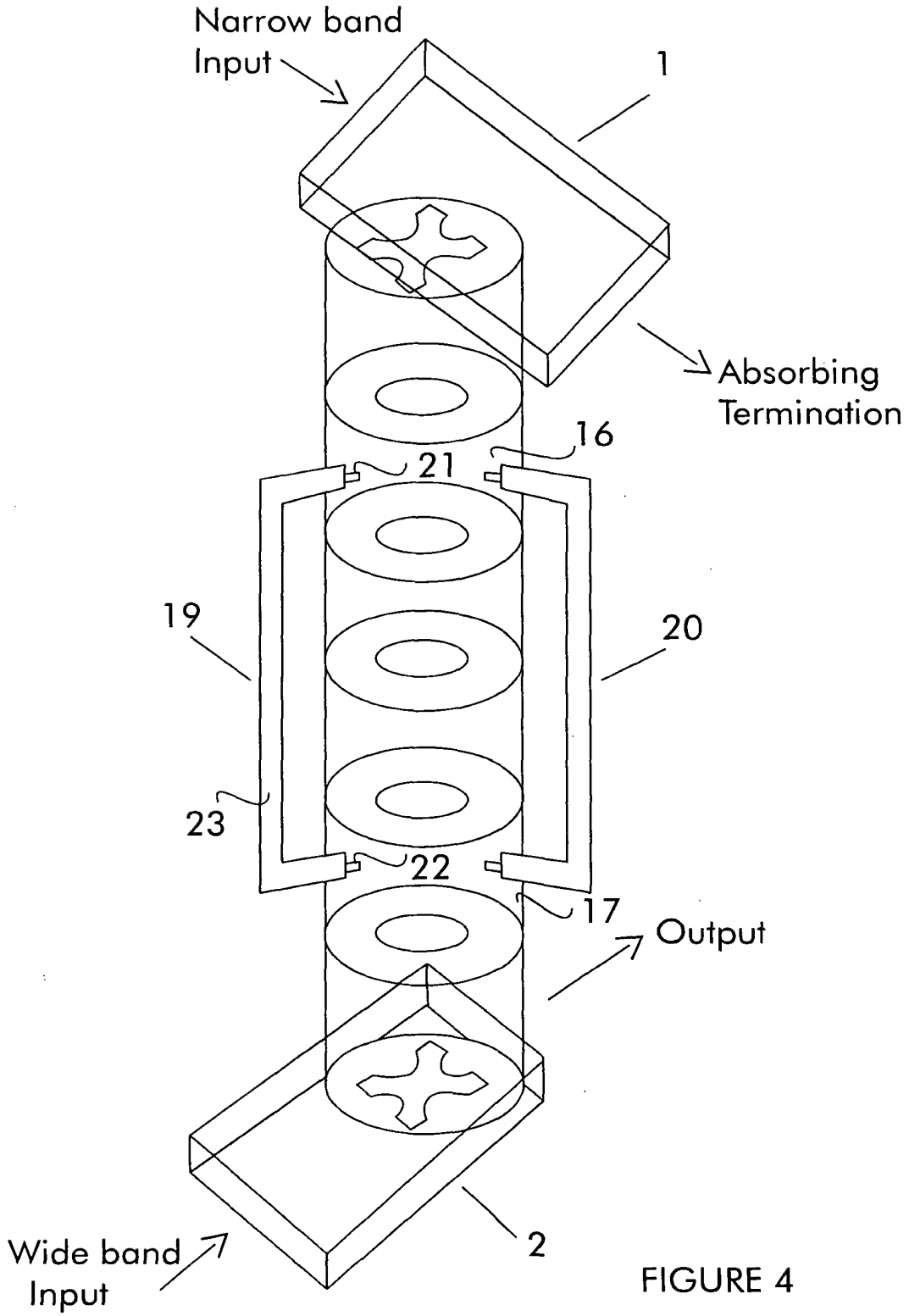
Narrow band
Input
1
Absorbing
Termination
16
21
19
20
23
22
17
Output
Wide band
Input
2

FIGURE 4